Research Project 1/2

Mitigating Alkali Silicate Reaction in Recycled Concrete

Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

Project Objectives

- To assess the susceptibility of concrete containing Recycled Concrete Aggregate (RCA) to the occurrence of alkali-silica reaction (ASR).
- To evaluate various mitigation strategies to prevent ASR in concrete containing RCA.
- To verify the applicability of existing test methods to control and /or eliminate the occurrence of ASR in concrete containing RCA.
- To establish relationships between laboratory and in situ performance, with respect to the occurrence of ASR.
- To develop guidelines for mitigating the occurrence of ARS in concrete containing RCA.

Project Progress

This two-phase, four-year project started in September 2000 with an overall goal of investigating new techniques to identify and mitigate alkali-silica reaction (ASR) in concrete made with recycled concrete aggregate (RCA). ASR is a chemical reaction between the alkaline pore water and silica in the aggregate that causes the formation of an expansive gel product that can lead to cracking and overall deterioration in the concrete. In phase one, Dr. Gress and graduate student Hugh Scott used a modified form of the ASTM C 1260 protocol to show that class F fly ash, silica fume, ground granulated blast furnace slag (GGBFS), low alkali cement, and lithium nitrate all provided some degree of ASR mitigation. ASTM C 1293 was then used to quantify the effectiveness of each strategy with regard to concrete made with RCA. It was found that RCA could be used in new concrete mixes, but compared to the virgin aggregate, the RCA needed higher doses of mitigation agent. It was also found that the absorption of mix water by the RCA significantly contributed to the early expansion of the test prisms. It is still unclear if the old paste in the RCA reactivates and contributes alkali to the new concrete mix, however, this could explain why higher doses are required for mitigation. Phase 1ended in August 2002. The second phase of the project builds off of the results obtained for the lithium nitrate mitigation strategy, but focuses on slowing or stopping ASR in distressed concrete. The basic idea is that externally applied lithium nitrate solutions will penetrate into ASR distressed concrete and minimize further damage. To test this hypothesis, Dr. Gress and graduate student Xinghe Li obtained 300 mm x 450 mm x 200 mm blocks of ASR distressed pavement from Interstate 95 in Maine and have been systematically evaluating lithium nitrate mitigation strategies. The blocks are stored at 38 C (100 °F) and 85-100% relative humidity (ASTM C 1293 conditions) to accelerate ASR growth and to speed evaluation of different mitigation strategies. The long-term expansion of the blocks is being monitored to determine if the solutions are able to slow or stop the ASR. Some pavement blocks were cut to the smaller ASTM C 1260 size to accelerate lithium nitrate migration into the samples. Initial results from the small blocks show that externally applied lithium nitrate solution does actually retard further expansion due to ASR.

Graduate student Xinghe Li uses a pore water extraction device to test samples of recycled concrete aggregate (RCA) and standard concrete samples.

Project Partners

Pennsylvania DOT, Maine DOT, Wyoming DOT, FMC Lithium Corporation

End Products

Guidance for State DOTs regarding mitigation strategies for alkali-silica reaction (ASR) in Portland Cement Concrete structures and a recommendation to AASHTO or ASTM for a new test to evaluate the ASR potential of both conventional and RCA concrete.

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement between the University of New Hampshire and the Federal Highway Administration, is a national center that promotes the appropriate use of recycled materials in the highway environment. Its focus is on the long-term performance and environmental implications of using recycled materials.

For detailed quarterly progress reports for Project 1/2, as well as all RMRC-funded research projects, please see: http://www.rmrc.unh.edu/Research/researchlevel2.asp.

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